PFEIFER
ISOFER

Swiss
Hazard
Protection

06/2014

# DEBRIS STOP 200-HM

## Protection Barrier against Spontaneous Shallow Landslides

DEBRIS STOP


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# The rising risk of debris flows

According to PLANAT, 6 % of all Swiss territory could potentially be affected by the threat of landslides. As a result of global climate change and the associated increase in heavy precipitation, landslides on steep slopes are likely to become more frequent. An increase in such events must therefore be anticipated in the future.

Spontaneous, shallow landslides and debris flows, in which vegetation is sliding together with the water-saturated topsoil, are a highly dynamic process. Once in motion, the mixture of stones, wood, soil, vegetation and water flows downhill at a speed of up to 35 km/h.

Until now, vulnerable areas such as roads, railwaylines and exposed buildings have been protected by reinforced walls or dams. However, a more efficient and cost-effective method of protection has now been developed in the form of the flexible „DEBRIS STOP 200-HM“ debris flow protection system.

1 Granular debris flow, Hong Kong

2 Spontanous shallow landslide, Switzerland

3 Debris flow hazard, Lantau Island, Hong Kong

# Protection concept: Effective protection against debris flows

Our ISOSTOP rockfall barriers have performed against numerous landslides and showed impressively the protection they offer against hillslides.

PFEIFER ISOFER subsequently developed an optimised debris flow system that was successfully tested in a 1:1 scale test in summer 2012.

The DEBRIS STOP 200-HM system consists of hinged mounted HE pillars supported by retaining ropes, brake elements, upper and lower support ropes and a net known as the FLEXNET. Brakes on the support ropes and post heads ensure that energy is dissipated as required. Loads can be transferred to the ground by the various options of anchoring products.

At a height of 3.5 m, the system can withstand pressure reaching up to 200 kN/m$^2$. This compactly designed system is therefore clearly superior to conventional protective measures.


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1 DEBRIS STOP 200-HM detail-screen

2 Debris flow protection with the ISOSTOP barrier

3 DEBRIS STOP 200-HM general view

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# The Components


## FLEXNET

The new patented FLEXNET is characterized by a high energy absorbtion and also a high flexibility. Impacted by a debris flow the FLEXNET provides the draining of the debris material and minimizes the load on the system.


## Break element

The key element of the DEBRIS STOP system is the brake element with linear course of force along the entire brake path. Its simple construction and the low weight allow an easy handling.

## Net attachment

For cable-protecting sliding of the net on support cables and faster installation, the net of the DEBRIS STOP barrier are fixed by shackles. In case of maintenance, net sections can be easily opened and the system can be unloaded.

## Columns and base plates

HE profiles are used in the post design of the DEBRIS STOP series. The transport and installation weight is thus comparatively low, which is a special benefit for helicopter installation.

## Anchoring

For anchoring the DEBRIS STOP system PFEIFER ISOFER provides several types of anchors:

- Spiral cable anchors
- Bow-plate for anchor rods
- Ear anchor for anchor rods

## Packaging

The DEBRIS STOP FLEXNET can be easily folded during the production, so the space for transprtation and storage is reduced enormously. Optionally, the net can be premounted to the posts.

# The proof of a high absorption capacity

The DEBRIS STOP 200-HM system has demonstrated its impressive capacity against shallow landslides by means of comprehensive testing in 1:1 scale.

Using a test site specially developed for this experiment, a total of 50 $m^3$ of debris flow material with a density of approx. 1,900 $kg/m^3$ was poured down a slide with a length of 55 m. The test system was built on a steep slope (in excess of 40°) with the aim of achieving a speed similar to that of debris flows at 10 m/s.

Another typical characteristic of debris flows is the sudden release of the sliding mass. To open the container hatches at the same time, the ropes holding them in place were severed in controlled detonations and the material was suddenly released.

A total of 10 load cells with a sampling rate of 1,200 measurements per second gathered extensive load data. Two high-speed cameras were installed in front and side positions so that the filling process could be monitored as closely as possible.


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1 Release device

2 Load measurement on post

3 Entire test set-up


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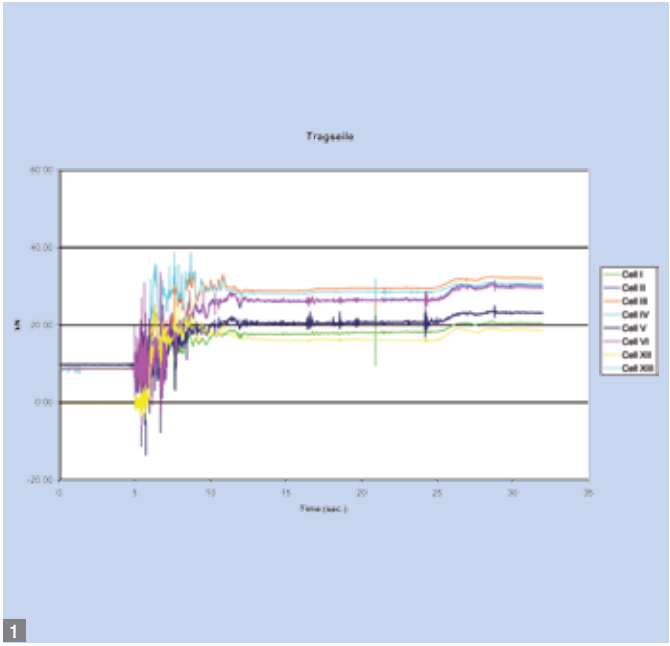
# Test results

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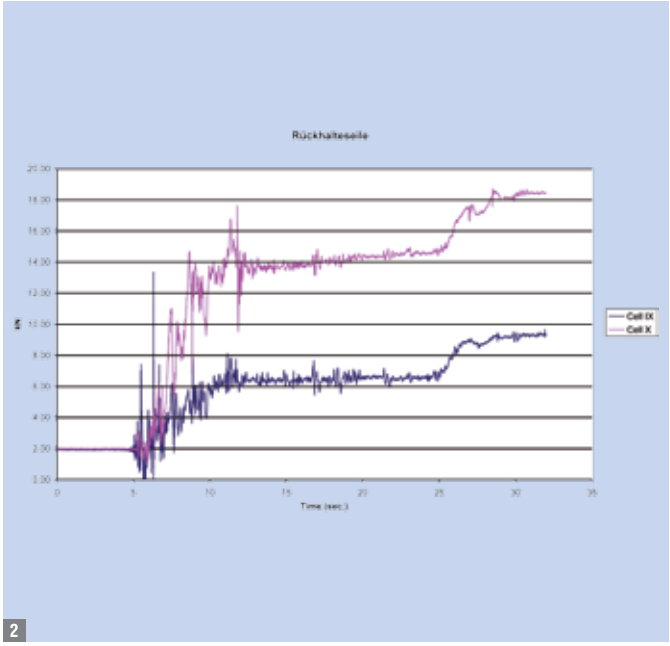


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The test results illustrate the key characteristics of a debris flow. It was noticed that, due to material drainage, internal friction in the net increases as it traps the sliding mass and leads to the formation of a wedge of earth that reduces the dynamic load on the contact front.

This behaviour is demonstrated in particular by the level of force existing on the retaining ropes, where high load values can only be observed at the beginning of the filling process.

The DEBRIS STOP 200-HM contains brake elements and the FLEXNET to reduce this impact stress. During the test, the FLEXNET absorbed almost all of the impact energy of the debris flow. This caused the net to stretch by 0.8 m. The material was directed from the middle of the net to the lateral fields so that the pressure could be distributed more evenly.

With the exception of the FLEXNET, no system components suffered plastic deformation. The system still has reserves for a maximum pressure of 200 kN/m$^2$, making it possible to fight further debris flow incidents.

1 Force diagram for support ropes

2 Force diagram for retaining ropes

3 DEBRIS STOP 200-HM filled up

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# Technical Data ISOFER DEBRIS STOP 200-HM

| Product | |
|---|---|
| Resistance | 200 kN/m² |
| System height | 3.5 m |

| Support Structure | |
|---|---|
| Type of post | HEB 200, zinc coated EN ISO 1461 |
| Ground plate | Type Looseground/Rock, zinc coated EN ISO 1461 |

| Interception strucutre | |
|---|---|
| Net | FLEXNET |
| Mesh | 250 x 250 mm |
| Mesh-rope (Ø) | 12 mm Steelrope EN-12385-4, zinc coated EN 10244-2 Cl.B |
| Additional layer | Hexagonal wire mesh |
| Mesh | 80 x 100 mm |
| Mesh-wire (Ø) | 2.7 mm, zinc coated EN 10244-2 Cl. A |

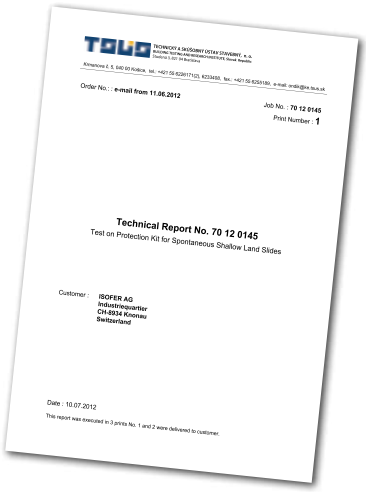
| Brakes | |
|---|---|
| Type of brake | Rope brake |
| Braking cable (Ø) | 18 mm / 24 mm |
| Braking distance | 1500 mm / 2500 mm |

| Ropes | |
|---|---|
| Main cable (Ø) | 22 mm Steelrope EN-12385-4, zinc coated EN 10244-2 Cl.B |
| Lateral cable (Ø) | 24 mm Steelrope EN-12385-4, zinc coated EN 10244-2 Cl.B |
| Retention cable (Ø) | 22 mm Steelrope EN-12385-4, zinc coated EN 10244-2 Cl.B |

| Connecting components | |
|---|---|
| Shackle | EN 13889, zinc coated |
| Bow cable clip | EN 13411, chromated |

| Anchoring | |
|---|---|
| Post anchor | GEWI bar D = 32 mm |
| Lateral anchor | GEWI bar D = 32 mm |
| Retention anchor | GEWI bar D = 32 mm |

| Approval | |
|---|---|
| Test report | TSUS European Testing Institute |



Technical Report No. 70 12 0145
Test on Protection Kit for Spontaneous Shallow Land Slides

Customer : ISOFER AG
Industriequartier
CH-8614 Kooneu
Switzerland

Date : 10.07.2012

## Product benefits at a glance

- Tested under survey of an official testing and research institute (TSUS)
- Tested in realistic flow conditions
- Capture of an impact force of 200 kN/m²
- FLEXNET provides the draining of the debris material
- Overload cables provide the structural integrity in overload cases
- Easy to install
- Easy maintenance due to modular construction
- Low anchor forces
- Patented individual parts

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